Myslim PASHA

MAPS AT SCALE 1:25 000 – A VISION TO ACHIEVE INTEGRATION AND COMMON STANDARDS: CASE OF ALBANIA

Pasha, M.: Maps at scale 1:25 000 – a vision to achieve integration and common standards: case of Albania. Kartografické listy 2007, 15, 6 figs., 1 tab., 9 refs.

Absatract: The objective of this paper is to provide information on regional efforts in Albania to comply and convert the maps at the scale 1:25 000, into digital database according to NATO-standards, as a result of the intensive changes of land cover and society. After political vocation and "wind of change" to democracy, the mapping activities are not seen as a routine but the "mirror" of actuality and the future spectrum of developments. The 1:25 000 is a base map manageable for all studies on the environment and its impact assessment of national and regional planning projects. In addition, there have been specific efforts to revise these maps, as a strategic and technical goal to use the geoinformation and resources that have been gathered and prepared over the years in order to make it available for the economy and society. This work has already begun. In addition, the paper introduces a historical overview on the background and the evolution of the project, followed by a brief technical and combination of basic technology and priorities to store the databases of geographic information systems by using digital methods. The 1:25 000 mapping has a coherent intention of scientific & technical work, which is bringing a "new face" of Albanian geospace, with "boom changes" during transitory period. Finally, it shows different applications on generating and updating spatial database by using "old" vector maps and new digital orthophotos. The new technology has been continuous strategy to implement and combine digital workflow in progress as a more flexible method of cost reduction and user's satisfaction. Of outstanding significance is the checking of final mapping product, accompanied with geometric assessment of the deviation errors. Problems, particularities, for the processes and phases are briefly described for each layer of map content, introducing them to the digital way.

Key words: base map, digital database, vectorization, digital orthophotos, geometric assessment of the deviation errors, Albania

Background of the mapping panorama in Albania

Until the end of last century as a result of the continuous efforts in Albania, topographic maps were provided as the most important source of geoinformation for the entire country. The spectrum of scales integrated maps at scale 1:25000 – 1:1 000 000, and partly 1:10 000, for Lowland of Albania. It was as a chain of processes, in time and geospace with multi-functional references which played an important role for the development, implementation and improvement of studies and projects.

Multipurpose applications, the character of maps and the growing level of requirements on their quality/quantity of content, put them in front of the users and decision makers as the main source of geoinformation systems on the national level for a long time.

In general, the Albanian cartographic system was performed according to the following Eastern Standards:

– Krassowsky ellipsoid,
– coordinate system 1942,
– Transversal Cylindric Gauss-Krüger Projection,
– base orthometric elevation from "0" level, Adriatic Sea.

Assoc. Prof. Dr. Myslim PASHA, Instituti Gjeografik Ushtarak i Shqipërisë, Rruga "M. Keta", Tirana, Albania, e-mail: pashajfamily@yahoo.com.

The scale 1:25 000 was considered for the National Base Map of Albania. It was a bridge between large and small scales. The role and position of this scale included the possibility to foresee its graphic representation, accuracy, and base information (http://www.swisstopo.ch) in order to update the small scales. The work for creation of 1:25 000 map for Albania began at the end the 1990's.

Aerial photographs were the prior "raw material" of land cover situation reflected on the maps. This was the case for a long period until, the cartographic products were introduced in the early 1980's as a scientific "picture" of the land. During the period from 1970 – 1987, 357 map sheets were prepared, which were revised twice.

The performance history of these maps was a rich professional experience with rigorous technical requirements. State triangulation network (ground control points with absolute error for reciprocal neighbor points realized: **+/- 12,5 cm**) was a mathematical "capture" secure. The mean square horizontal graphic error for compilation originals was: **0,25 mm x scale** (6,25 meters), which satisfied the technical requirements. Meanwhile, in elevation, the deviation of relief was no more than: **1/10 x h**, where: "*h*" is the main contour interval, (10 meters) (Podobedov 1970). These geometric requirements of the position, for the two dimensions deviations (horizontal & vertical) of the content of maps 1:25 000, were a reality needs to be taken into consideration and could not be disregarded.

General overview

The boom of changes after the democratic movement was a new reality, not only for Albania but for all Eastern European countries which experienced fundamental economical and social transformations. Albania was a very particular case because it came out of an extremely "self isolated society" and the democratic changes were a tremendous transformation, at times resulting in anarchy rather then in an organized and well managed process. Albanians went through the so-called "free movement" which brought migration of the population from mountainous zones to the metropolitan areas in the Lowland of Albania, in the West, accompanied with intensive dynamic changes of land cover (Pasha and Zeka 2003) and land use. The government did not have the possibility to take the adequate measures to manage the situation and stabilize the movement. Change of ownership and transformation of mentality; modern & regional European projects for the future of market economy were the real cohesion that required a joined and integrated geoinformation system as an essential part for the future.

The demands to update the maps was an emergency for managing geospace, environment and natural resources, handling, storing, maintaining, and providing the data in the framework of regional and international commitments; within the framework of sustainable development. Existing cartographic productions were a "treasure" and "a portrait document" of geoinformation, which had a real value in identifying the level of development and achievements made. But these products had different geocartographic standards which were not in compliance with the global spectacular modern technology, international & regional interoperability as well. Before the 1990's, the 1:25 000, was the base and "pioneer" of all other small scales in terms of their creation and revision.

From 1994, a geodetic and cartographic campaign began, to convert datums and geoinformation by combining the classical and new technology, as an integral part of consistent compilation of compatible modern cartographic products. 1:50 000 map was the first updated product. It was followed by JOG (Joint Operation Graphics 1:250 000) (http://www.esri.com/news /arcnews/ fall05articles/gis-for-the-nation.htm), Euro Regional Map 1:500 000, and Euroglobal Map 1:1 000 000. But the performance of 1:25 000, remained according to the old standards. The situation required new treatment of data sources, in terms of generation, management, processing and the output of final mapping products for quality sharing the information.

Study concept

It was a real challenge to evaluate and convert datums (http://www.esri.com/news /arcnews/fall05articles/gis-for-the-nation.htm) of the geodetic standards of the mapping productions of old times, selecting them and concentrating their values, which preserved a firm technical use.

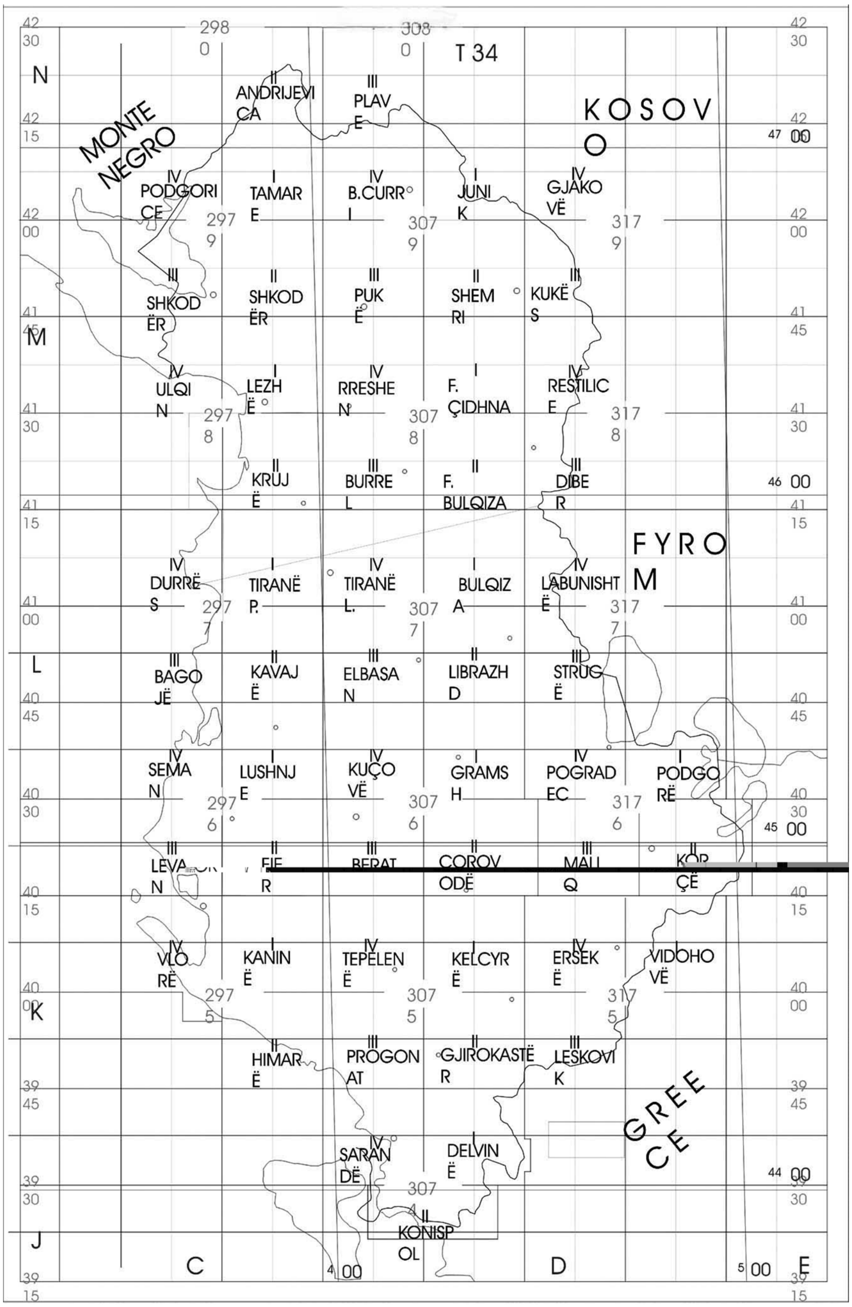

Fig. 1 Index of maps 1:25 000

Inside them were experiences which should not be ignored. The process of vectorization was done using the scanned stable positive films materials of original compilation layers which were elaborated through: ArcView, ArcGIS and ArcMap (ESRI 2005). This digital topographic database of earlier production was done through AutoCAD and digital elevation model (10 meters main contours), available in the same format. It was the foundation for the evaluation of the process through a deep glance on scientific & technical view, as a combination of quality & quantities of the data created. This project covered the data capture process of mapping production aimed to produce regenerated maps.

The study concept as a universe included:
– GIS technology, using all sources of geoinformation,
– contribute for regional studies,
– urban master plans and studies,
– prevention of natural disasters and civilian emergencies,
– industry developments,
– cadastral mapping integration,
– tourism requirements, etc.

The main principle should be “not to ignore what scientific and technical mapping achievements realized” but “to evaluate, select and combine”.

Based on this viewpoint, the proposed project focused on the following issues:
– The analyze, control and evaluate the existing mapping products.
– The conversion according to the new geocartographic standards (WGS-84, International Ellipsoid, UTM projection) (http://www.esri.com/news/arcnews/fall05articles/gis-for-the-nation.htm).
– The control of the changes on land cover, (settlements, Artificial surfaces, transport and communications), which used to be reflected on new map, totally or partly through interpretation of digital orthophotos.
– Selection of the content of the map converted totally, (relief & hydrography layers) from the digital format to the new map.
– Implementation step by step through digital technology to compose a unique final map.

The quality checking and attribute completion needed to be done in order to prevent the errors. The pathway of strategy to the new geodatabase should be passed on the bridge, which linked existing accepted map content converted with representation of changes in land cover (Pasha and Zeka 2003) through new technologies. Thus, the combination of two experiences was the common denominator to be used, in order to gain the ability of conversion and integration for consistent accuracy of seamless data. Establishing the database was the beginning of the future.

The studies of accumulated changes in land cover

The last edition of updated maps 1:25 000 took place at the end of 1986 (ITU 1987) (Fig. 2), with the third regeneration of this scale at the national level. This reality was evaluated as a long period for technical map revision. The delay was the result of the impact of political changes that forced the review of the structures and mandates of mapping agencies.

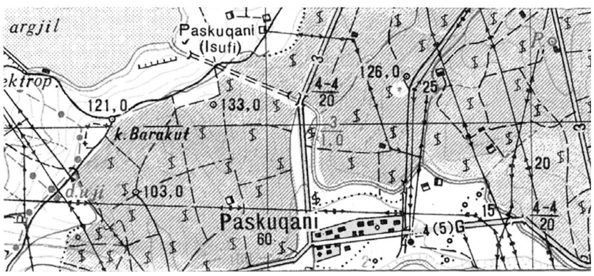

Fig. 2 Fragment of the content of old map (1985)

The 10 years revision period is considered a limit for the dynamic changes. The updating period had passed two times its technical limit. The comparative model had two views: old map and reality of land cover (Pasha and Zeka 2003). Satellite images (Fig. 3) represented clearly this reality in terms of comparison.

The proposal is examined in three situations showed from the zoning of Albanian geospace:
(a) when the changes, were more than 60 % (mostly densely populated regions),
(b) the changes ranged between 25-60 %,
(c) the changes were less than 25 %.

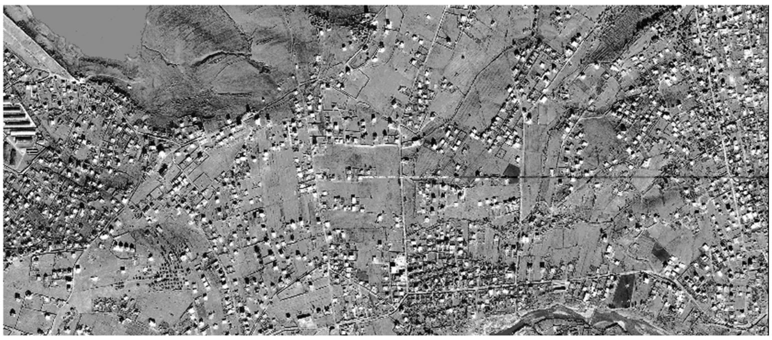

Fig. 3 The dynamic changes in the same area

Each region had a particular treatment on the process of regeneration by selecting the proper scheme and method. The same preliminary comparison was accomplished for the vegetation and hydrography, as well. For the regions (http://www.swisstopo.ch) (a) was decided the complete revision of the content of the layer to be corrected, updated and field checked by using and interpreting digital aerial photographs (orthophotos) or satellite images through remote sensing. For the regions (b), (c) there was a need to evaluate the main content of the layer and partially, on it to reflect digitally the interpreted changes.

The vectorized base map

The vectorized unity map (of old system) as a base map was necessary to be evaluated for conversion under new standards. If the project should be treated as a virgin beginning, (from its basics) there would be a need for big unnecessary and very costly work. Under these conditions the selected variant predicted:

– the evaluation of geometric deviation of the content of map (vector format) for each layer,
– the determination of changes occurred in land cover.

The criteria for feature revision were based on:

– amount of changes on the geospace (spatial and semantic) (ESRI 2005),
– the geometric precision of the existing features,
– topology,
– significance of the feature.

Many features needed revision though interpretation of image sources, such as orthophotos or digital aerial photographs. The revision was accomplished using a variety of processes.

Feature content that could reliably be identified on imagery or ancillary sources was revised during basic revision. The continued portrayal of artificial surfaces layer (built-up areas, transportation, equipment energy & telecommunication) (Pasha and Zeka 2003) as very intensive layer of big dynamic and obvious evidence changes had two alternatives to compile. If the changes in the land cover were more than 60 %, version (a) – the compilation should be processed from the beginning as a complete revision, using all the possibilities for data information, digital orthophotos, satellite images or urban and cadastral data (Fig. 4). For the regions (b), (c) it evaluated the main content of the layer and partially above it to reflect digitally the interpreted changes (Fig. 5).

If the changes are less than 60 %, the compilation proceeded as a combination. Orthoimage was acquired to revise "old" map data. Having the digital aerial photographs and its orthophotos, all the data were orthorectified through digital process being ready in geodetic standard and cartography geometry. Digital photogrammteric method used for implementing modern digital technology of map compilation and revision.

For the area covered by the experimented map, digital aerial photographs (Buchroithner 2000) were selected, flown at the scale 1:10 000. The DTM (http://www.swisstopo.ch) was computed on 10 meters and accuracy was 2.5 meters, from relief digitized of old map.

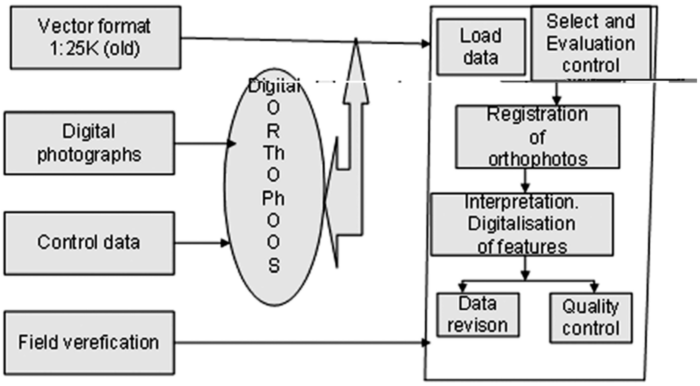

Fig. 4. Data flow for revision, using orthophotos.

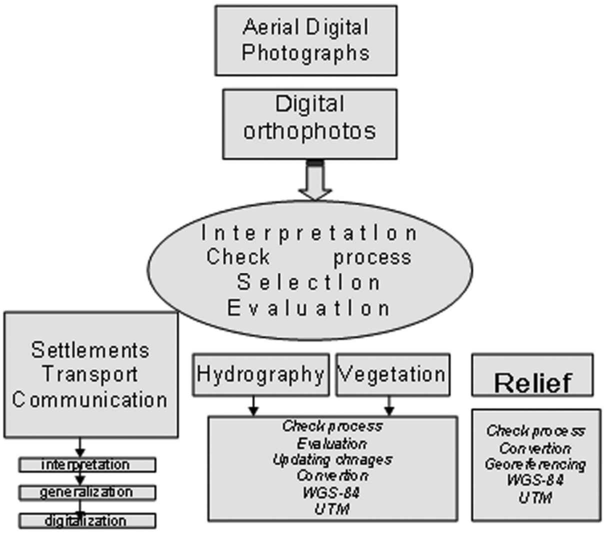

Fig. 5. The scheme of layer‘s revision

One of most effective methods for the extraction of new data was by comparison and superimposition of the existing “old” digital vector data with “new digital orthophotos” (digital ortho-image mosaics). The image was already orthorectified. So the regeneration of database was performed by the collecting new information from the image. The onscreen digitalization of topographic details and changes were necessary to be reflected on the new map. Attribute changes in the data were applied, based on the information collected during the field works.

Vegetation layer had to be evaluated as well. The long period of “uncontrolled shock interventions in vegetation” on the most part of land cover, has brought about dramatic changes which had to be reinterpreted and converted to the new map, keeping in mind modern requirements for the environment and ecology. Vegetative surface (Pasha and Zeka 2003) was evaluated on an individual map basis to determine if it required revision or not. When the types of woodlands, orchards, vineyards and various types of vegetation were in evidence of obvious change of more than 60 %, then the revision was performed in full.

Relief layer, compared with the old map, as a natural content of “nudo” land cover was subject to very slow and untrackable changes with the exception of natural disasters (river flooding, earth slide, heavy erosion etc.). In these cases, the unity of relief should be checked for geometric deviation errors and then converted digitally to new compose 1:25 000 map. Relief layer has a content ready for convertion into new standards. Creating it from the beginning is not the proper way, when its unity was accomplished through photogrammetric method, controlled inside of the composed map. Another peculiarity was that the vectorized relief and its carriage were not so complex, but easy. The contour lines parameters coincide with actual altimetry requirements. The process therefore was reduced only to convert it by the digital method in a new updated map. There was a need to check fragments of relief using independent specified heights on the field for a secure altimetry situation.

Hydrography layer has an untrackable change in time compared to vegetation and settlements. This was necessary to partially check through orthophotos, for new deviations of drainage (flow of rivers, beaches, channels) which did not require total representation of the layer, but only reflection of the changes. Previously mapped water bodies were modified if it had obvious evidence of change. Characteristics describing streams as perennial or intermittent were not revised unless the information had been verified on the ground.

New mapping standards and interpretability

It is time to have precise information and products in easily understood formats. Interoperbility enables community users to find a product readable, usable and enhancement of environmental studies by improving access data from this scale. The modern fusion of spatial geoinformation reflected and created in 1:25 000, will accelerate the growing customers need for a common, digital view of geospace. In this point of view the cartographic products are not “isolated univers” for only a part of community users, but belong to the wide spectrum, providing relevant and accurate maps in common reference framework for planning decisions integrated for regional and international projects.

The symbology as the map language was an issue which required to be addressed. All symbols in the map 1:25 000 were harmonized according to the Eastern Standards, with very small differences. Interoperability needed to have homogenized efforts to carry out a map which could be read and use easily from the community users in Europe for the common activities. Albania had a program to combine and harmonize the specification and symbology preventing the “shock” changes (therapy?), and respecting the general view of specifications familiar for the users, and in the same time interfering carefully to change and improve some qualities on shape and content of map.

It is accepted that, the “marginal”(IGUS 2001) of map 1:25 000, to be showed out of the map frame (http://earth-info.nga.mil/GandG/publications/puborder.html) with symbology and geocartographic data was in order to facilitate, read and use easily the map. This “window” includes: the projection, system of coordinates, size, map face, grids, glossary, series of map, hipsometry vision etc.

For the 1:25 000 some changes were proposed as:

– marginal,
– separated houses,
– concept of block in populated places and its color,
– high electrical and telecommunications lines, which make more readable and attractive the content in the framework of Global Mapping and all standardization of NATO and European Community, as well (ITU 1987, Pasha and Zeka 2003).

Geometric processing and evaluation

Every process has graphic errors that accumulate at the final detailed portrait of the map. The revised map should maintain the positional accuracy of the previously published map. The existing 1:25 000 map has a mean graphic error of no more than 0,25 mm X scale and it is accepted inside

this product. It will be transmitted directly in new map manipulating it through some processes including:
m_{geo}, mean square error of determination of horizontal control points,
m_{d}, mean square error of map content digitalization (each layer: relief, hydrography, vegetation),
m_{geo}, mean error of georeferencing of contents in the frame of creation of new map.

Thus, the updated map has new reality of position of details which at the final product will be checked through ground control points.

Mapping requirements for the 1:25 000 can be expressed by three parameters:
1. horizontal accuracy (Ground Control Points),
2. altimetry accuracy (DEM – Digital Elevation Model),
3. object dedectability.

Position deviation has map accuracy standards that usually define absolute error (standard deviation of positioning) which constitutes **2 times** the graphic mean square error: **2 x 0,1 mm x scale** (25 000). For 1:25 000 the deviation standard of positioning is **+/- 5 m**.

Conventionally map altimetry accuracy standards defined permissible depends on the main contour interval, which for our scale is 10 meters. However, in flood planes for Lowland of Albania the contour interval is 1 meter. On any case it had a different accuracy. In our experiment, the alternative was to transmit to the updated map, the existing relief surveyed photogrammetrically. By analyzing it, it results that the mean square height error is no more than **1/10 x h** (contour interval). But the standard deviation is probably: **2–3 x $\mathbf{m_h}$**. (m_h is the mean square height error) (Buchroithner 2000).

Tab. 1 Mean square height error

Contour interval (h)	Standard deviation
10 m	+/- 3 m
2 m	+/- 0,6 m
1 m	+/- 0,3 m

It was useful to evaluate whether the existing feature was within the cartographic tolerance and to collect the revisions, respecting cartographic requirements.

The existing contours were compared visually to the ones generated from the derived DTM used for the production of the digital orthoimages. The preliminary comparison showed that it was not necessary to replace them (Fig. 6).

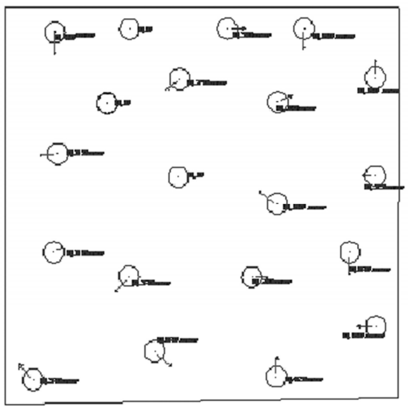

Fig. 6 Field checking process of geometry deviation through independent control points through GPS

Quantitative analysis in our final experiment map, involving the residuals on ground control points, showed that the errors on independent check points which have not been included for processing, were compared within final composed map.

For final geometry checking deviation of content a geodetic network performed through GPS was designed in a harmonized distribution of independent ground control points on vectorized model. It computed and processed according to the new datums. These points were used not only for horizontal geometry deviation, but for the altimetry as well. Passing through many processes for creation of the vectorized model, the different errors were present. It was indispensable to check the geometric deviations. After the calculations digitally, the coordinates were reflected on the vectorized model. Analyzing the results it is obvious the conclusion that:

– graphical geometric absolute deviations: 0,0 – 15 mm, consist, 20 %; 0,15 – 0,30 mm, 35 %; 0,30 – 0,50 mm, 5 % and 0,50 – 0,60 mm consist: 40 % of all of points (see Fig. 6),
– mean geometric absolute deviation for wholly (full) model results: **0,28 mm x scale** which is acceptable as a permitted graphic error,
– it showed that the deviations were no more than **3 times** the mean height square error of the contour interval.

Conclusions

1. 1:25 000 as the national base map will be developed for heads-up data capture purpose bringing it through digital working out as contemporary requirements.

2. A strategy towards interagency standards and guidelines for creating and delineating the compilation was highlighted as a process that should be used for developing a seamless nationally consistent geospatial data, revising existing maps and providing a proper guidance that will be incorporated into the new map 1:25 000.

3. Geocartographic standards and interoperability were materialized under the NATO framework NATO (WGS-84, International Ellipsoid, UTM-projection), converting them according to the modern digital technologies.

4. The dynamic changes evaluated on nature and society for the revision of maps predicting the zoning of three divisions:

– geospaces with intensive changes > 60 %,
– geospaces with changes 25-60 %,
– geospaces with changes < 25 %.

For each category is proposed the proper technology scheme for the process of revision.

5. The experiment showed the approach and result unity map composed digitally combining the existing geoinformation, revised with new changes & converting to the new standards.

6. Digital orthophotoimages at scale 1:10 000, are fresh and very accurate data which bring the modern alternative for the quick transformation and implementation of geoinformation through new GIS technologies, digital photogrammetry and ArcInfo software.

7. For quantitative analysis of the final experiment of compilation of vector format map, the residuals on independent ground control points were involved, showing that the errors were in the frame of mean graphic deviation error.

8. The modern fusion of spatial geoinformation reflected and created in 1:25 000 will accelerate the growing customers need, for a common, digital view of geospace. In this point of view the cartographic products are not an "isolated universe" for only a part of community users, but belong to the wide spectrum, providing relevant and accurate maps in common reference framework for planning decisions integrated for regional and international projects.

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R e s u m é

Mapy v mierke 1:25 000 – predstava integrácie a spoločných štandardov na príklade Albánska

Cieľom príspevku je informovať o regionálnych snahách v Albánsku „prepísať“ mapy v mierke 1:25 000 do digitálnej databázy podľa štandardov NATO v dôsledku vyvolania intenzívnych zmien krajinnej pokrývky a spoločnosti. Po politickej voľbe demokracie sa mapovacie aktivity nepovažujú iba za rutinné, ale sú „zrkadlom“ reality a budúcim spektrom vývoja. Základná mapa v mierke 1:25 000 je vhodná pre všetky environmentálne štúdie a hodnotenie vplyvov na krajinu v rámci národných a regionálnych plánovacích projektov. Okrem toho, že boli špecifické snahy revidovať tieto mapy, strategickým a technickým cieľom je použiť geoinformácie a zdroje dát, zhromaždené a pripravené počas niekoľkých rokov tak, aby boli dostupné pre rôzne využitie. Uvedené práce už začali.

Okrem toho, príspevok poskytuje historický pohľad na pozadie a vývoj projektu, ďalej je zmienka o základnej technológii a prioritách na uchovanie dátových vrstiev v GIS-e použitím digitálnych metód. Mapovanie v mierke 1:25 000 je kontinuálny postup vedeckých a technických krokov, ktoré poskytujú „novú tvár“ albánskeho geopriestoru s výraznými zmenami v procese transformácie.

Príspevok dokumentuje v závere rôzne aplikácie spojené s generovaním a aktualizáciou priestorovej databázy použitím starých vektorových máp a nových ortofotosnímok. Nová technológia je pokračovaním stratégie implementovania a spájania progresívnej a flexibilnejšej metódy z hľadiska nižšej ceny a užívateľskej spokojnosti.

Mimoriadny význam má kontrola finálneho produktu mapovania, spojená s hodnotením jeho geometrických chýb. Pre každú vrstvu obsahu mapy sa v príspevku charakterizujú problémy a zvláštnosti, predstavené v kontexte digitálneho prístupu.

Obr. 1 Klad listov máp v mierke 1:25 000

Obr. 2 Časť obsahu starej mapy (1985)

Obr. 3 Dynamické zmeny na tom istom území

Obr. 4 Tok dát pre revíziu využívajúci ortofotosnímky

Obr. 5 Schéma revízie vrstiev

Obr. 6 Proces terénnej kontroly geometrickej odchýlky prostredníctvom nezávislých kontrolných bodov zameraných pomocou GPS

Tab. 1 Stredná kvadratická chyba výšky

Lektoroval:

Doc. RNDr. Ján FERANEC, CSc.,
Geografický ústav SAV, Bratislava